DOCUMENT RESUME

ED 066 519 TM 002 003

TITLE	Radiographer (any ind.) 199.381--Technical Report on Development of USES Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	S-391
PUB DATE	Feb 67
NOTE	16p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Evaluation Criteria; High School Graduates; Job Applicants; *Job Skills; Norms; Occupational Guidance; *Personnel Evaluation; *Radiographers; Test Reliability; Test Validity
IDENTIFIERS	GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample and a personnel evaluation form are also included. (AG)

February 1967 United States Employment Service Technical Report S-391

S-391

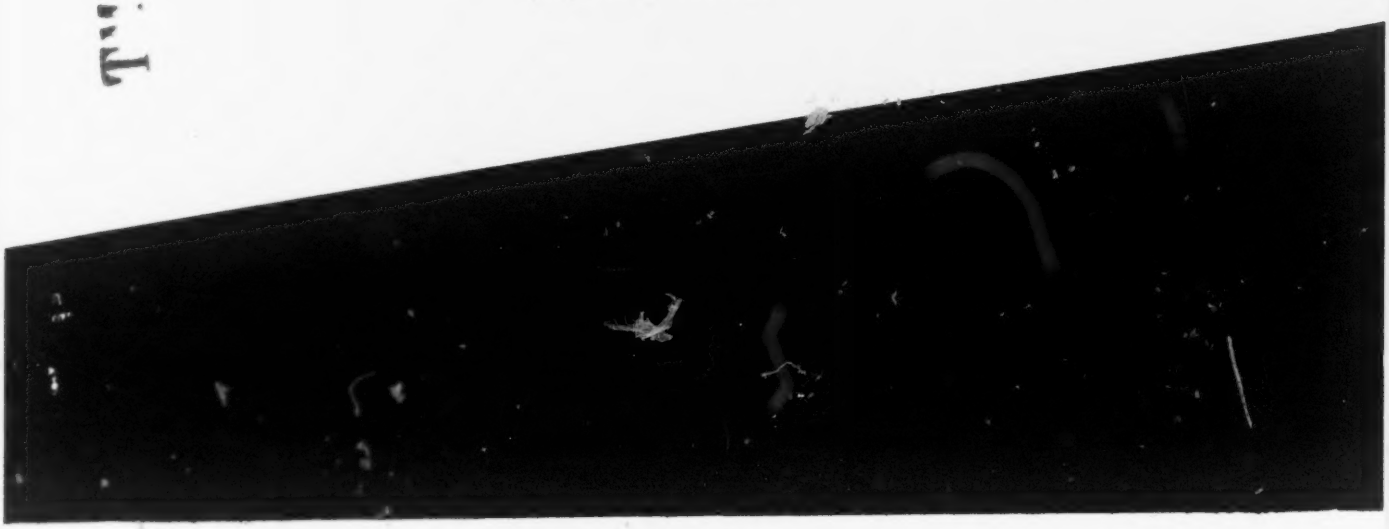
ED066519

T: 002 003

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Development of USES Aptitude Test Battery for Radiographer

(any ind.) 199.381



U.S. DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary
MANPOWER ADMINISTRATION
BUREAU OF EMPLOYMENT SECURITY
Washington, D.C. 20210

Technical Report on Development of USES Test Battery

For .....

Radiographer (any ind.) 199.381

S-391

U. S. Employment Service
in Cooperation with
Connecticut and Mississippi State Employment Services

February 1967

FOREWORD

The United States Training and Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

GATB Study #2639

Development of USES Aptitude Test Battery

For

Radiographer (any ind.) 199.381
S-391

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Radiographer (any ind.) 199.381. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB, B-1002 Scores
P - Form Perception	85
Q - Clerical Perception	95
F - Finger Dexterity	80

RESEARCH SUMMARY

Sample:
27 male workers employed as Radiographers in Connecticut, and 21 male workers employed as Radiographers in Mississippi.

Criterion:
Supervisory ratings

Design:
Concurrent (test and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations, and selective efficiencies.

Concurrent Validity:
Phi coefficient = .51 (P/2 less than .0005)

Effectiveness of Norms:
Only 73% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the above norms, 86% would have been good workers. Twenty-seven percent of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the above norms, only 14% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	73%	86%
Poor Workers	27%	14%

SAMPLE DESCRIPTION

Size:
N = 48

Occupational Status:
Employed Workers

Work Setting:
Groton, Connecticut and Pascagoula, Mississippi

Employer Selection Requirements:

Education:
Connecticut sample: High School graduate.
Mississippi sample: High School graduate, some college training preferred.

Previous Experience:
Connecticut sample: None; however, a large number of the examinees were former Navy men, and had gained some experience prior to separation from the Navy.

Mississippi sample: The company has three classifications which involve the application of varying degrees of skill and methods of radiography. The duties performed by the workers in this sample are those required by the highest of the three classifications. Previous employment in the two lower classifications within the plant for a total of approximately two years is required before promotion to the classification held by the workers in this sample. No experience is required at the entry classification.

Tests: No tests were used with either sample.

Other:
Connecticut sample: None
Mississippi sample: Personal interview, physical examination, record of knowledge and skill gained from experience and training in lower classifications within the plant, and results of examinations covering safety and performance aspects of the job.

Principal Activities

The job duties of each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience

Connecticut sample: All workers had at least twelve months total job experience.
Mississippi sample: All workers had at least forty-six months total job experience.

TABLE 2

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

	Mean	SD	Range	r
Age (years)	31.7	7.2	23-55	-.362*
Education (years)	12.4	1.0	10-16	-.263
Experience (months)	60.0	39.6	12-240	-.174

*Significant at the .05 level

EXPERIMENTAL TEST BATTERY

All 12 tests of the GATB, B-1002B, were administered during November 1965 and February 1966.

CRITERION

The criterion data consisted of supervisory ratings of job proficiency made at approximately the same time as test data were collected. Ratings and reratings were made by the immediate supervisor of each worker in the Connecticut sample with a five week interval between ratings. Ratings and reratings were made by the Radiographic Quality Control Superviosr who was familiar with the performance of all the workers in the Mississippi sample, with a four week interval between ratings.

Rating Scale: USES Form SP-21 "Descriptive Rating Scale." This scale (see Appendix) consist of nine items covering different aspects of job performance. Each item has five alternatives corresponding to different degrees of job proficiency.

Reliability: The coefficient of reliability between the two ratings for 46 of the sample was .93 indicating a significant relationship. A second rating was not available for two individuals in the Connecticut sample; therefore, the initial rating on these two individuals was doubled. Since it was apparent that the ratings of the Mississippi sample were more conservative than those of the Connecticut sample, the final criterion score consisted of the combined score of the two ratings converted to standard scores with a mean of 50 and a standard deviation of 10.

Criterion Score Distribution:

Range of the combined Standardized Scores:	31-68
Mean:	49.9
Standard Deviation:	10.0

Criterion Dichotomy: The criterion distribution was dichotomized into high and low groups by placing 27% of the sample in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were designated as "good workers" and those in the low group as "poor workers". The standardized critical criterion score of 45 corresponds to the raw critical criterion score which properly divides the Mississippi sample.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties involved and a statistical analysis of test and criterion data. Aptitudes G, N, P and Q which do not have a significant correlation with the criterion were considered for inclusion in the norms because the qualitative analysis indicated that these aptitudes were important for the job duties, and the sample had a relatively low standard deviation on Aptitude N and relatively high mean scores on Aptitudes G, P and Q. With employed workers, a relatively low standard deviation indicates that some pre-selection may have taken place, and this restricted range of scores (low standard deviation) will depress the correlation between the aptitude and the criterion. A relatively high mean score with employed workers may also indicate some sample pre-selection. Tables 3, 4 and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the Aptitudes indicated appear to be important to the work performed)

Aptitude	Rationale
G-General Learning Ability	To acquire necessary knowledge of required radiographic techniques, safety regulations, and operating and emergency procedures; to comprehend such reference materials as technique books and manuals and to determine which technique to apply; to train assistants in radiographic techniques and use of equipment.
V-Verbal Aptitude	To explain and demonstrate techniques and equipment used in radiographic exposures to assistants; to understand and discuss technical material and instructions.
N-Numerical Aptitude	To apply standard formulae when computing exposure time, angles of exposure and distances to set up equipment and perimeters of safety areas.
P-Form Perception	To check and to position equipment; to read radiation instruments to determine the exact radiation level; to perceive pertinent details in exposed film.
Q-Clerical Perception	To check and to prepare a large variety of records on equipment used, techniques applied, film exposed and components tested; to adjust and check equipment dials, such as timers, kilovoltage and milliamperage dials; to review work assignments prepared with a large number of coded references and instructions.

F-Finger Dexterity	To set up equipment; to adjust controls; to position film; to allign and assemble lead numbers and letters; tape penetrameter identifying lead numbers, head of source tube, and lead shielding in place; to manipulate monitoring and etching equipment; to thread cable hose and source tube into camera lock.
M-Manual Dexterity	To crank source into and out of camera, to set up rope barriers and warning signs; to carry and place equipment in position at work sites.

TABLE 4

Means, Standard Deviations (SD), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes for the GATB; N = 48.

Aptitudes	Mean	SD	Range	r
G-General Learning Ability	111.3	15.2	83-146	.149
V-Verbal Aptitude	104.0	15.1	72-129	.094
N-Numerical Aptitude	111.0	14.5	82-140	.058
S-Spatial Aptitude	111.9	17.7	78-143	-.016
P-Form Perception	111.3	17.7	68-156	.032
Q-Clerical Perception	118.3	15.6	93-161	.035
K-Motor Coordination	109.5	16.7	32-153	.014
F-Finger Dexterity	98.7	20.6	58-140	.300*
M-Manual Dexterity	106.3	19.2	70-155	.193

*Significant at the .05 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important	X	X	X		X	X		X	X
Irrelevant									
Relatively High Mean	X			X	X	X			
Relatively Low Standard Dev.			X						
Significant Correlation with Criterion								X	
Aptitudes to be Considered for Trial Norms	G		N		P	Q		F	

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of Aptitudes G, N, P, Q, and F at trial cutting scores were able to differentiate between the 73% of the sample considered good workers and the 27% of the sample considered poor workers. Trial cutting scores at five-point intervals approximately one standard deviation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two-aptitude trial norms, minimum cutting scores of slightly higher than one standard deviation below the mean will eliminate about one-third of the sample; for four-aptitude trial norms, cutting scores of slightly lower than one standard deviation below the mean will eliminate about one-third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. Norms of P-85, Q-95, and F-80 provided the highest degree of differentiation for the occupation of Radiographer (any ind.) 199.381. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .51 (statistically significant at the .0005 level).

TABLE 6

Concurrent Validity of Test Norms, P-85, Q-95, and F-80

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	4	31	35
Poor Workers	8	5	13
Total	12	36	48

Phi Coefficient = .51

Chi Square (X^2) = 12.7

Significance Level = P/2 less than .0005

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study did not meet the requirements for incorporating the occupation studied into any of the 36 OAP's included in Section II of the Manual for the General Aptitude Test Battery. The data for this sample will be considered for future groupings in the development of new occupational aptitude patterns.

SP-21
Rev. 2/61

A-P-P-E-N-D-I-X

DESCRIPTIVE RATING SCALE
(For Aptitude Test Development Studies)

Score____

RATING SCALE FOR _____
D. O. T. Title and Code

Directions: Please read Form SP-20, "Suggestions to Raters", and then fill in the items listed below. In making your ratings, only one box should be checked for each question.

Name of Worker (print) _____
(Last) (First)

Sex: Male_____ Female_____

Company Job Title: _____

How often do you see this worker in a work situation?

☐ See him at work all the time.

☐ See him at work several times a day.

☐ See him at work several times a week.

☐ Seldom see him in work situation.

How long have you worked with him?

☐ Under one month.

☐ One to two months.

☐ Three to five months.

☐ Six months or more.

A. How much work can he get done? (Worker's ability to make efficient use of his time and to work at high speed.)

☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.

☐ 2. Capable of low work output. Can perform at a slow pace.

☐ 3. Capable of fair work output. Can perform at an acceptable but not a fast pace.

☐ 4. Capable of high work output. Can perform at a fast pace.

☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of his work? (Worker's ability to do high-grade work which meets quality standards.)

☐ 1. Performance is inferior and almost never meets minimum quality standards.

☐ 2. The grade of his work could stand improvement. Performance is usually acceptable but somewhat inferior in quality.

☐ 3. Performance is acceptable but usually not superior in quality.

☐ 4. Performance is usually superior in quality.

☐ 5. Performance is almost always of the highest quality.

C. How accurate is he in his work? (Worker's ability to avoid making mistakes.)

☐ 1. Makes very many mistakes. Work needs constant checking.

☐ 2. Makes frequent mistakes. Work needs more checking than is desirable.

☐ 3. Makes mistakes occasionally. Work needs only normal checking.

☐ 4. Makes few mistakes. Work seldom needs checking.

☐ 5. Rarely makes a mistake. Work almost never needs checking.

D. How much does he know about his job? (Worker's understanding of the principles, equipment, materials and methods that have to do directly or indirectly with his work.)

☐ 1. Has very limited knowledge. Does not know enough to do his job adequately.

☐ 2. Has little knowledge. Knows enough to "get by."

☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.

☐ 4. Has broad knowledge. Knows enough to do good work.

☐ 5. Has complete knowledge. Knows his job thoroughly.

E. How much aptitude or facility does he have for this kind of work? (Worker's adeptness or knack for performing his job easily and well.)

☐ 1. Has great difficulty doing his job. Not at all suited to this kind of work.

☐ 2. Usually has some difficulty doing his job. Not too well suited to this kind of work.

☐ 3. Does his job without too much difficulty. Fairly well suited to this kind of work.

☐ 4. Usually does his job without difficulty. Well suited to this kind of work.

☐ 5. Does his job with great ease. Exceptionally well suited for this kind of work.

F. How large a variety of job duties can he perform efficiently? (Worker's ability to handle several different operations in his work.)

☐ 1. Cannot perform different operations adequately.

☐ 2. Can perform a limited number of different operations efficiently.

☐ 3. Can perform several different operations with reasonable efficiency.

☐ 4. Can perform many different operations efficiently.

☐ 5. Can perform an unusually large variety of different operations efficiently.

G. How resourceful is he when something different comes up or something out of the ordinary occurs? (Worker's ability to apply what he already knows to a new situation.)

☐ 1. Almost never is able to figure out what to do. Needs help on even minor problems.

☐ 2. Often has difficulty handling new situations. Needs help on all but simple problems.

☐ 3. Sometimes knows what to do, sometimes doesn't. Can deal with problems that are not too complex.

☐ 4. Usually able to handle new situations. Needs help on only complex problems.

☐ 5. Practically always figures out what to do himself. Rarely needs help, even on complex problems.

H. How many practical suggestions does he make for doing things in better ways? (Worker's ability to improve work methods.)

☐ 1. Sticks strictly with the routine. Contributes nothing in the way of practical suggestions.

☐ 2. Slow to see new ways to improve methods. Contributes few practical suggestions.

☐ 3. Neither quick nor slow to see new ways to improve methods. Contributes some practical suggestions.

☐ 4. Quick to see new ways to improve methods. Contributes more than his share of practical suggestions.

☐ 5. Extremely alert to see new ways to improve methods. Contributes an unusually large number of practical suggestions.

I. Considering all the factors already rated, and <u>only</u> these factors, how acceptable is his work? (Worker's "all-around" ability to do his job.)

☐ 1. Would be better off without him. Performance usually not acceptable.

☐ 2. Of limited value to the organization. Performance somewhat inferior.

☐ 3. A fairly proficient worker. Performance generally acceptable.

☐ 4. A valuable worker. Performance usually superior.

☐ 5. An unusually competent worker. Performance almost always top notch.

February 1967 S-391

FACT SHEET

Job Title

Radiographer (any ind.) 199.381-010

Job Summary

Radiographs weldings, metal samples, pipes, machinery, and structural members of ships and submarines to detect flaws, cracks, porosity, weld voids, and presence of foreign objects, using X-ray equipment or sealed sources of radioactive isotopes such as Iridium 192, Cessium, or Cobalt 60.

Work Performed

Reviews work assignments to determine information such as ship hull number, compartment or work site, pipe, shell or material to be radiographed, material thickness, frame number, and specific area to be exposed to gamma or X-ray. Selects equipment such as penetrometic, shim, collimator, mobile X-ray machine, survey instrument, camera containing radioactive isotopes, source tube, and control cable assembly from equipment room according to specifications of radiographing technique. Tests safety of equipment using radiation survey instrument and checks decay chart to verify strength of source in curies.

Posts information such as model and serial number of camera or exposure device, type of source, strength of source at time used and name of person using source and equipment onto utilization log to maintain record for inventory and safety purposes.

Ropes off area and posts warning signs to prevent unauthorized personnel from entering radiation area following chart specification for establishing estimated perimeter of safety. Attaches identifying lead numbers to film using masking tape and tapes lead backing to film holder to shield film from scattered radiation. Computes time of exposure to control uniform film density for quality of radiograph, following charts and applying mathematical formulae. Places lead shield at head of source tube to prevent exposure to other areas. Positions camera at specified angles for shooting pipe or hull welds. Turns crank of control cable assembly to project worm core of cable through camera forcing source into head of source tube. Records time source cranked out, scheduled time to be cranked in, actual time cranked in, radiation level measured at camera, and initials on log to comply with State Health regulations.

Sets up X-ray equipment and safeguards and shoots radiograph at work site or in laboratory. Selects and tapes penetrameter and shim to component and tapes film to component or positions film with lead backing to reduce radiation scatter on work table. Computes distance of X-ray tube head to film, degree of angle X-ray, and exposure time following chart and using

mathematical formulae. Pushes lever to open shutter on X-ray tube head, starts machine, sets timer, and adjusts filament regulator to control milliamperage. Sets potential strength meter at determined kilovoltage. Pushes button to energize filament and keeps area under surveillance during exposure using radiation survey instrument.

Removes exposed film holder from component and completes record of exposure setting and equipment data. Marks position of identifying number on component using etching tool. Carries exposed film and record of exposure setting and equipment data to film laboratory for processing.

Effectiveness of Norms

Only 73% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-391 norms, 86% would have been good workers. 27% of the non-test-selected workers used for this study were poor workers; if these workers had been test-selected with the S-391 norms, only 14% would have been poor workers.

Applicability of S-391 Norms

The aptitude test battery is applicable to jobs which include a majority of duties described above.

DEPARTMENT OF LABOR
UNITED STATES OF AMERICA

PUBLIC EMPLOYMENT SERVICE
LOCAL · STATE · NATIONAL